REMARKS

In the Office Action, the Examiner continued to reject claims 1-7 under 35 U.S.C. § 102(b) as anticipated by Lifshits (US 6,062,848). The Examiner also continued to reject claims 15-21 under 35 U.S.C. § 102(b) as being anticipated by Knight (US 5,718,573). The rejections of claims 8-11, 12-14, 22-25 and 26-28 under 35 U.S.C. § 103(a) as being unpatentable over various combinations of references were also repeated.

It is respectfully submitted that the present invention is patentably distinguishable from the cited references. The proposed amendments to independent claims 1 and 15 make the primary distinction between the invention as claimed and the cited references even more clear.

By clarifying what Applicants consider to be a patentable distinction from the cited references, it is submitted that the proposed amendments present the rejected claims in better form for consideration on appeal. The proposed amendments were not earlier presented because they were not considered necessary in order to distinguish the claims from the prior art. In any event, it is believed that it is appropriate under 37 C.F.R. § 1.116 for the Examiner to enter the proposed amendments and reconsider the claims in view thereof. Support for the amendments can be found, for example, in paragraphs 22 and 23 of the specification.

The Rejection of Claims 1-7 under § 102(b) as Anticipated by Lifshits

As amended, independent claim 1 calls for the secondary fuel gas nozzles to be located separate and remote from the radiant wall burners such that the secondary fuel gas is not encapsulated or surrounded by the fuel gas-air mixture from the radiant wall burners thereby allowing secondary fuel gas to mix with flue gases in the furnace prior to mixing with the fuel gas-air mixture. This element clearly distinguishes independent claim 1 from Lifshits.

The significance of the above limitation is explained in the specification and understood by those skilled in the art. The following is set forth on pages 6 and 7 of the specification (as amended):

> [0022] Referring now to the drawings, FIG. 1 depicts a traditional burner column 11 of staged fuel radiant wall burners 10. The staged fuel radiant wall burners 10 consist of radiant wall burner tips 12 which are provided with a fuel gas lean mixture of primary fuel gas and air. Secondary fuel gas risers 14 supply the secondary fuel gas tips 16 thereof with fuel gas. The location of the secondary fuel gas tips 16 is typically in the centers of the radiant wall burner tips 12 as shown in FIG. 1, or around the perimeters of the radiant wall burner tips 12. As shown in FIG. 1, the fuel gas-air streams exiting the burner tips 12 form barriers 18 and 20 and encapsulate or surround the secondary fuel gas 22. The fuel gas-air barriers 18 and 20 around the secondary fuel gas 22 prevents sufficient entrainment of flue gas 24 resulting in increased NO_X emissions. *(emphasis added)*
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> [0023] In the remote staged fuel technique of the present invention, the secondary fuel gas from or adjacent each radiant wall burner 10 is eliminated. Instead, the secondary fuel gas is injected into the furnace at a remote location. As shown in FIG. 2, by moving the secondary fuel gas to a remote secondary fuel gas nozzle 26 located, for example, below the burner column 11, the secondary fuel gas 22 is able to mix with the furnace flue gases 24 prior to mixing with the fuel gas-air mixture 18 in the combustion zone 28. It has been found that by using one or more remote secondary fuel gas nozzles 26 positioned at remote locations and providing secondary fuel gas patterns, reduced NO_X emissions are achieved as well as improved flame quality compared to state-of-the-art radiant wall burner designs. *(emphasis added)*

The example described on page 8 and the corresponding data represented by the graph of FIG. 8 demonstrate that NO_X emissions are reduced by 50% using the remote staging configuration of the invention as represented by FIG. 2 and described above.

In view of the above, the Examiner's statements in the final Office Action that "applicants' specification merely defines separate and remote as the secondary nozzles below or offset the radiant wall burners" (bottom of page 5) and that "secondary flue gas mixing and

excess air combustion, as claimed, is synonymous with the disclosed flue gas entrainment and remaining combustion air mixture" (middle of page 6) are not understood. The Examiner's characterization of the specification's definition of "separate and remote" is not accurate. The entrainment of partially cooled combustion products surrounding the flame as disclosed by Lifshits is not synonymous with the furnace flue gas mixing achieved by the secondary fuel gas in accordance with the invention.

Unlike the inventive apparatus as called by independent claim 1, the secondary fuel gas injection tubes of Lifshits are not separate and remote from the primary fuel gas spuds such that the secondary fuel gas is not encapsulated or surrounded by the fuel gas-air mixture from the radiant wall burners thereby allowing it to mix with flue gases in the furnace prior to mixing with the fuel gas-air mixture. Rather, the Lifshits burner functions more like the burners discussed in paragraphs 5 and 22 and shown by FIG. 1 of the present specification.

The secondary fuel gas ports in Lifshits are "located around the periphery of the air ports array." (See Col. 3, lines 17-21.) "The pattern of secondary fuel injection in general is such that the secondary fuel jets penetrate in between the jets of air and primary fuel, or products of its combustion." (Col. 4, lines 16-19.) Consequently, the secondary fuel gas ports in Lifshits are neither "separate" nor "remote" from "an array of radiant wall burners" as called for by independent claim 1.

Thus, Lifshits does not anticipate independent claim 1. The Examiner's rejection of claim 1 on this basis should be withdrawn.

Likewise, claims 2-7 are not anticipated by Lifshits because they depend from a patentable claim. Moreover, these claims each include one or more limitations not disclosed by the prior art relied upon by the Examiner. For example, Lifshits does not teach an array of

secondary fuel gas nozzles arranged in at least one row adjacent to rows of radiant wall burners as in claims 2, 4, 5, 6, and 7. This reference merely discloses secondary fuel gas nozzles concentrically disposed around the periphery of a single burner plate. Lifshits does not disclose rows of burners together with rows of secondary nozzles. Thus, the rejection of claims 2-7 should also be withdrawn.

The Rejection of Claims 15-21 under § 102(b) as Anticipated by Knight

The Knight method is entirely different from the method of claim 15. The instant invention provides for a method of staged fuel burning. Knight, on the other hand, discloses a method of staged fuel mixing prior to injecting the mixture into the furnace. (See Col. 2, lines 31-33 and Col. 3, lines 6-10.) In fact, this reference teaches a method that is completely contradictory to the instant invention. For example, in Knight, the mixture of primary fuel gas and air is not caused to flow outward from each radiant wall burner across the wall of the furnace to be burned at a relatively low temperature as provided in step (b). Instead of burning the primary gas-air mixture, the burner in Knight utilizes aerodynamic mixing techniques to create a noncombustible primary gas-air mixture. (Col. 1, lines 48-53; Col. 2, lines 33-37.)

Further, Knight fails to teach the limitations recited in step (c) of claim 15. As amended, independent claim 15 calls for the step of providing secondary fuel gas from secondary fuel gas nozzles for mixing with flue gases in the furnace and combusting with excess air from the radiant wall burners, lowering the temperature of the burning fuel gas and reducing the formation of NO_X. As claimed, the secondary fuel nozzles are located separate and remote from the radiant wall burners such that the secondary fuel gas is not encapsulated or surrounded by the mixture of fuel gas and air from the burners thereby allowing secondary fuel gas to mix with flue gases in the furnace prior to mixing with the mixture of fuel gas and air from the burners.

According to Knight, the secondary fuel gas is not mixed with flue gases in the furnace and does not combust with excess air from the burners. Instead, the secondary fuel gas is added to the noncombustible primary fuel gas-air mixture inside a burner to form a combustible fuel-air mixture which "slows to a velocity that will support combustion." (See Col. 1, lines 53-57; Col. 2, lines 60-65; Col. 3, lines 24-20.) The exhaust gases are "removed from the combustion chamber by an induced draft fan through a flue. (See Col. 4, lines 9-10.)

Moreover, "lowering the temperature of the burning fuel gas and reducing the formation of NO_X" in step (c) is not inherent in the disclosed flashback flame resistance purportedly achieved in Knight. The problem of flame flashback occurs internally within a single burner. Knight proposes reducing the incidence of flashback by employing aerodynamic techniques to create a noncombustible primary fuel gas mixture. The noncombustible mixture in Knight is then accelerated to a velocity higher than the flame speed of a combustible mixture of the primary fuel and air. "The high flame speed flow creates an aerodynamic barrier to flame propagation that prevents flash back." (Col. 2, lines 31-59.) The reduction of flashback inside the burner by increasing the velocity of a noncombustible primary fuel gas-air mixture is completely unrelated to the reduction of temperatures of burning secondary fuel gas outside the burner.

Thus, Knight fails to teach all of the limitations of and therefore does not anticipate independent claim 15. The Examiner's rejection of claim 15 should also be withdrawn.

This Knight reference also fails to teach the limitations of dependent claims 16-21. Knight teaches a method in which a secondary fuel nozzle is located inside a burner, rather than configured in rows adjacent to rows of radiant wall burners. Nothing in Knight suggests that the

secondary fuel gas nozzles should be located in rows adjacent to the rows of radiant wall burners. As a result, the rejection of claims 16-21 should also be withdrawn.

The Rejection of the Remaining Claims under § 103

Even if the combinations of references asserted by the Examiner would result in the present invention as claimed (which is not the case), the claimed invention would not have been obvious at the time it was made. As discussed in Applicants' last response, there is nothing in the prior art that would have motivated one skilled in the art to combine the references in the manner set forth by the Examiner. Accordingly, a prima facie case of obviousness has not been established.

Thus, the Examiner's rejections of the claims under 35 U.S.C. § 103 should also be withdrawn.

In view of the proposed amendments and the above remarks, the Examiner is respectfully requested to allow claims 1-28 at this time. This is intended to be a complete response to the final Office Action.

I hereby certify that this correspondence is being deposited in the United States Postal Service as first class mail in an envelope addressed to: Mail Stop AF, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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Date: September 29, 2005

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